

## **Summary of Ultralightweight Ballute Technology Advances**

Jim Masciarelli (Ball Aerospace & Technologies Corp., 1600 Commerce St., Boulder CO 80301, 303-939-5146, [jmasciar@ball.com](mailto:jmasciar@ball.com))

Kevin Miller (Ball Aerospace & Technologies Corp., 1600 Commerce St., Boulder CO 80301, 303-939-6550, [klmiller@ball.com](mailto:klmiller@ball.com))

Ultralightweight ballutes offer the potential to provide aerodynamic deceleration for space science and exploration missions that require entry or aerocapture at without high heating rates on the host spacecraft, and with much lower mass than traditional technologies. This innovative concept involves deployment of a large, lightweight, inflatable aerodynamic decelerator (ballute) whose large drag area allows the spacecraft to decelerate at very low densities high in the target planet's atmosphere with relatively low heating rates. Because the vehicle using the ballute decelerates at much higher altitude, the peak heating rate is significantly lower than for entry using a traditional lunar return capsule. The lower heating rates experienced during atmospheric entry allows the use of lightweight construction techniques for the ballute, resulting in significant mass performance advantages.

Key technical challenges associated with ultralightweight ballute technology include materials survivability, techniques for ballute construction, packaging, and deployment, flow stability, aeroelastic stability, and trajectory control. A team consisting of Ball Aerospace, ILC Dover, Georgia Tech, NASA Langley, NASA JSC, and the Jet Propulsion Laboratory has been working to advance this technology over the past few years under funding provided by NASA's In-Space Propulsion Program, and NASA's Exploration Systems Research and Technology Program. This presentation summarizes the work accomplished to advance this technology.